

IN THE CLAIMS

The following listing of claims will replace all prior versions, and listings, of claims in the application.

Claim 1 (previously presented). An analytical method for analyzing a liquid sample using near infrared spectroscopy comprising the steps of:

- (a) applying near infrared light in the short wavelength range of 700 nm to 1100 nm to the liquid sample as disposed within a sample test tube from outside the sample test tube;
- (b) detecting at least one of diffusely reflected light, diffusely transmitted light, and transmitted and reflected light from the liquid sample by an optical sensor to measure a near infrared absorption spectrum of the liquid sample; and
- (c) comparing the measured spectrum value to a calibration equation which has been determined in advance, thereby determining object characteristics of the liquid sample,

wherein said calibration equation is determined from a near infrared absorption spectrum of a liquid reference sample with known object characteristics, which liquid reference sample is disposed within a plurality of test tubes having substantially the same optical specifications as said sample test tube, and

wherein light having a wavelength of 700 nm-1100 nm is applied to a ceramic plate which is a reference material so as to obtain an intensity of the light transmitted through the ceramic plate as a reference value for measurements of said optical sensor involving said sample test tube and said plurality of test tubes having substantially the same optical specifications as said sample test tube.

Claim 2 (canceled).

Claim 3 (previously presented). The analytical method for analyzing a liquid sample using near infrared spectroscopy according to claim 1, wherein the liquid sample is selected from the group consisting of food, rumen juice, urine, oil, industrial waste water, and lake water.

Claim 4 (previously presented). The analytical method for analyzing a liquid sample using near infrared spectroscopy according to claim 1, wherein a plurality of ordinary test tubes with substantially the same optical specifications are used interchangeably as the test tubes in the spectrum measurement of the reference sample in determining the calibration equation.

Claim 5 (previously presented). An analytical apparatus for analyzing a liquid sample comprising:

a plurality of interchangeable test tubes having substantially the same optical specifications;

a block provided with a housing portion which receives one of said test tubes containing the liquid sample therein;

a near infrared apparatus provided with a spectroscope for dispersing near infrared light having a wavelength of 700 nm - 1100 nm from a source of light or the sample and an optical sensor for detecting the near infrared light;

light conduction means for conducting the dispersed near infrared light to the test tube within the housing portion and for conducting, directly or through the spectroscope, at least one of diffusely reflected light, diffusely transmitted light, and transmitted light and reflected light

from the liquid sample within the test tube to the optical sensor; and

control means for outputting a measurement command of a spectrum to the near infrared apparatus and for modifying the measured spectrum using a calibration equation which has been determined in advance, for thereby computing object characteristics of the liquid sample, and

a ceramic plate, as a reference material, to which said near infrared apparatus applies light having a wavelength of 700 nm – 1100 nm so as to obtain the intensity of light transmitted through the ceramic plate as a reference value for measurements of said optical sensor involving said plurality of interchangeable test tubes.

Claim 6 (previously presented). The analytical apparatus for analyzing a liquid sample according to claim 5, wherein a white light source is used as the light source, and a diode array is used as the optical sensor.

Claim 7 (previously presented). The analytical apparatus for analyzing a liquid sample according to claim 5, wherein monochromatic near infrared light in a short wavelength range is used as the light source, and a silicon detector is used as the optical sensor.

Claim 8 (previously presented). The analytical apparatus for analyzing a liquid sample according to claim 5, wherein the light conduction means comprises an optical fiber.

Claim 9 (previously presented). The analytical apparatus for analyzing a liquid sample according to claim 5, wherein the block is provided with a temperature control means for stabilizing the liquid sample within the test tube at a predetermined temperature.

Claim 10 (previously presented). The analytical apparatus for analyzing a liquid sample according to claim 5, wherein the interchangeable test tubes are ordinary test tubes.

Claim 11 (previously presented). The analytical apparatus for analyzing a liquid sample according to claim 5, wherein said calibration equation is determined in advance from a near infrared spectrum measured by the analytical apparatus using a liquid reference sample with known object characteristics and with the liquid reference sample disposed in a plurality of the interchangeable test tubes.

Claim 12 (previously presented). The analytical apparatus for analyzing a liquid sample according to claim 11, wherein ordinary test tubes with substantially the same specifications are used as the interchangeable test tubes in the spectrum measurement of the liquid reference sample.

Claim 13 (previously presented). The analytical apparatus for analyzing a liquid sample according to claim 5, wherein the light conducting means comprises a bundle of optical fibers.

Claim 14 (previously presented). The analytical method for analyzing a liquid sample using near infrared spectroscopy according to claim 1, wherein the sample test tube and the plurality of test tubes having substantially the same optical specifications as the sample test tube are ordinary test tubes.

Claim 15 (previously presented). The analytical method for analyzing a liquid sample using near infrared spectroscopy according to claim 1, wherein the calibration equation is determined from the near infrared spectrum of a plurality of liquid reference samples with known object characteristics, which are disposed in the plurality of test tubes having substantially the same optical specifications as said sample test tube, and wherein said spectrum is measured using said steps (a) and (b) relative to the liquid reference samples.

Claim 16 (previously presented). The analytical method for analyzing a liquid sample using near infrared spectroscopy according to claim 1, wherein said liquid sample is an unmodified field sample .

Claim 17 (previously presented). The analytical apparatus for analyzing a liquid sample according to claim 5, wherein the liquid sample is an unmodified field sample.

Claim 18 (previously presented). The analytical method for analyzing a liquid sample using near infrared spectroscopy according to claim 1, wherein an optical path length for the near infrared light in the short wavelength range is 1-2 cm.

Claim 19 (previously presented). The analytical apparatus for analyzing a liquid sample according to claim 5, wherein an optical path length for the near infrared light in the short wavelength range is 1-2 cm.